tract of the ether vapours in the Soxhlet apparatus is wrongly described, and the treatment of the subject of soil examination is crude.

Although it is not difficult to thus indicate many points with which a critic in this country may find fault, the work may with profit be consulted on many subjects, and none with greater advantage than that of Food.

The book is capitally printed and bound in two handy-sized volumes.

THE LATEST TEXT-BOOK OF GEOLOGY.

Text-Book of Geology. By Sir Archibald Geikie, Director-General of the Geological Survey of Great Britain and Ireland. Third Edition, revised and enlarged. (London: Macmillan and Co., 1893.)

IT goes very much against the grain, for it savours of ingratitude, to begin by picking holes in a book that has been a trusted companion, that has proved itself worthy of trust, and to which I have been so largely indebted, as the volume before me. But the strictures I feel bound to make are not very severe, and the blots I cannot help noticing do not impair seriously the value of the work—do not, indeed, detract at all from its usefulness in the case of a large number of readers.

The first point on which I have always differed from the author is this. In Book i., which deals with the cosmical aspects of geology, we are introduced to some of the darkest and most unsettled problems that arise when we concern ourselves with the earth's history; the stability of its axis, the degree of its rigidity, the causes of the changes of climate which have occurred in bygone days. Besides their obscurity these points have not a little in common, and much may be said in favour of grouping them together. But when we find it stated in the preface that the method of treatment adopted is one which the author has found, while conducting his geological class, to afford the student a good grasp of the general principles of the science, it is hardly possible to avoid doubting the wisdom of bringing them in at so early a stage. To do this is to run counter to that prime canon of teaching, which bids us start with the concrete, simple, and known, and lead thence up to the abstract, complex, and hypothetical. To the advanced student, who has already made the acquaintance of these unsettled points, such a summary as we have here of what has been done towards their solution is most valuable; but it is rather strong meat for the beginner. On just the same grounds I would object to putting in the forefront speculations as to the state of the earth's interior or her age. Something may be said in favour of an early notice of the nebular hypothesis, for it looks like beginning at the beginning. But to do this successfully we must have some certain knowledge of what the beginning was, and this we assuredly have not in the case of the earth. So greatly do I differ from the author's view as expressed in the preface that I always recommend students to omit large portions of Books i. and ii. on their first reading. In the same connection one may note that, on the principle that the father comes before the children, hypogene action precedes epigene action in Book iii. But on grounds already stated, I should be inclined to reverse the order.

Further, while all that style could do to render the work attractive has been done, I have found that the arrangement of its matter tends to render it at times rather hard reading. It is somewhat irritating, when you have begun to grow warm on some subject and want to know everything that is known about it, to be told that no more can be said here, but that some information has been given in a previous book, and that the subject is further discussed in a subsequent book. It is no great hardship to have to turn backwards or forwards, though a little hunting may be required to find the exact passage sought; yet these cross references do act as a check on the even flow of one's thought, and they occur pretty frequently. A little more elasticity and a little less consistency may be desiderated. Take the case of metamorphism. In Book ii. part 7, section iii. we have a description of the chief varieties of metamorphic rocks; then, under the head of Dynamical Geology, in Book iii., instances of the changes produced by metamorphism; lastly, in Book iv., which treats of the architecture of the earth's crust, we are told of some additional metamorphic changes and of the processes by which metamorphism is brought about. It is difficult to see why the last two sections should have been so widely separated for the process of metamorphism, specially of regional metamorphism, is a dynamical operation. It would have been a convenience and would have saved some repetition, to have had all these sections in continuous sequence; and it is instructive to notice how impossible is rigid adherence to systematic arrangement, for even in the descriptive section there are constant anticipations of the dynamical problems which are treated more fully later on.

There are other cases in which, for a similar reason, it will be found troublesome to gather into a connected whole all that the book has to tell on a specific subject; but the trouble will be well repaid, for it is a book almost exhaustive in its fulness, copiously illustrated, lucid in its descriptions, and a model of English in style. As an illustration of its thoroughly practical character, we may point to the minute directions on the subject of fossil-collecting at the end of Book v. On some of the more recondite and obscure problems of geology, the author has wisely refrained from attempting to decide between rival hypotheses; but he has summarised the more important speculative solutions that have been put forward, and has given such full references to the papers in which these appear, that the reader, who is so minded, can easily follow out the questions for himself. Indeed, throughout what may be called the physical side of geology, the book is a most exhaustive and trustworthy compendium, such as could be produced only by one who has a wide acquaintance with the literature of the subject, and who has also been brought face to face with what he describes by life-long and varied work in the field.

When we come to stratigraphical geology, it behoves the critic to be wary in his judgments. To treat this satisfactorily seems to me to be the most trying ordeal to which the writer of a text-book can be subjected. At the very threshold we are met with one of the most perplexing of geological problems, when we are called upon to decide between the rival claims of contemporaneity and homotaxis. The subject is discussed at some length by our author. A reference to Prof. Huxley's Anniversary Address (*Q. J. Geol. Soc.* xxvi. [1870] p. 43) might be usefully added to the note on p. 658. And when we pass from theoretical questions to matters of actual fact, the treatment of this branch of geology is no less difficult. How often does it consist of little else but tables of names of formations (comparative or otherwise), lists of fossils, and other statistical information, that make it about as lively as a parish register or a regimental roll-list. How often do we ungratefully curse for its dismalness a book of this kind, to which we are glad enough to turn for reference. And at first it looks as if this could not be helped, for if we are to give within reasonable compass only a summary of what is known of the stratigraphy of the world, what space is left for more than dreary statistics? Fortunately there are two matters directly arising out of the bare facts of stratigraphy, which give life to its dry bones: the light which the rocks of a region throw on its physical geography at the time they were formed, and the connection between the fossils of geological epochs and the general evolution of life on the earth. For these space must be found, because without these our narrative is no more geology than a list of dates is history. These points have not been lost sight of in the present text-book.

The oldest rocks of the earth's crust are in the present edition prudently grouped together under the head of pre-Cambrian. Of the many names given to these rocks all but this have involved more or less of unjustifiable assumption; but in this there is comparative safety, for whatever difference of opinion there may be about the upper limit of the Cambrian, there is a fairly general provisional agreement as to where its base is to be placed. The account of the pre-Cambrian rocks has been recast and amplified; the term is not used as a "dumping ground for everything of unknown age," but the claims of the rock groups described under this head to the antiquity which the name implies are canvassed. Additional details as to the recent work of the Geological Survey in the North-west Highlands are introduced. Attention is also called to the fact that portions of the Archæan schists have in more than one locality been shown to be intrusive, and that the amount of the Archæan has thereby been materially reduced. But it must not be overlooked in this connection that the pebbles in the conglomerates of the Torridian and other pre-Cambrian clastic rocks prove the existence of crystalline schists of Archæan type before these beds were deposited, and so leave a residue of Archæan rocks that no future discoveries can abolish. Further additions in the present edition deal with the rocks of the Central Highlands provisionally classed as Dalradian, and the researches of American geologists among their Fundamental Complex and Algonkian. The amount of new matter in this part of the book makes it practically a new work.

Within the space of this article it will not be possible to do more than glance at the many subsequent improvements. The account of the Silurian Rocks of North Wales is hardly up to date, and specially the treatment of the May Hill Beds leaves somewhat to be desired. The insertion of a table giving the results of Prof. Lapworth's work in the Southern Uplands of Scotland is a recognition that all geologists will welcome. The Devonian section is enriched by an account of the researches of Mr. Usher and Prof. Kayser. Under the head of the Carboniferous System the account of the distribution of the fossils of the English coal measures is hardly up to the mark. It is scarcely brought out with sufficient distinctness that the marine shells are found only in a few thin bands, and that these are by no means confined to the Ganister Beds. It is questionable, too, whether it was worth devoting so much space to the attempts of Grand'Eury and others to zone the carboniferous rocks by means of their plants. There are those among us who yet recollect Hooker's warning as to the value of specific distinctions between fossil plants, which has been since enforced by the discovery that two genera so seemingly distinct as Lepidodendron and Halonia are really different parts of the same plant. A most important addition to the Permian section is an account of the marine type of the Permian rocks, which, if I mistake not, now finds for the first time a place in an English text-book. Under the Jurassic section attention is called to Neumayr's speculations as to the climatic belts of that period. Among the Cretaceous deposits due notice is taken of the work of Mr. Lamplugh and Prof. Pavlow on the Specton Clay. The treatment of the Gault and Upper Greensand is hardly satisfactory. The views as to the relationship of these two groups, by no means new but largely enforced by the work of Mr. Jukes-Browne, are only indicated; and the reader will hardly gather that, as is stated so unhesitatingly in the last report of the Director-General of the Geological Survey, the two groups really constitute one formation. Have red-tape regulations here forbidden the author to give to the public the benefit of survey discoveries till they have been announced in an official form? This seems a pity, but red-tape is hardly likely to see it in this light. In the Gossau Beds we find a striking instance of the difficulty of keeping a book up to date; not many weeks have passed since a paper was read before the Geological Society, which will probably largely increase our knowledge of this somewhat exceptional formation. One very useful addition among the Tertiary Rocks is a fuller notice of Mr. Clement Reid's studies of the Cromer section.

The last book, on Physiographical Geology, is a little disappointing. The author has made earth-sculpture and other branches of this division of geology so specially his own, that we could have wished for more under this head than the concise summary he has given. True, he would have been repeating what he has said oftentimes before; but his contributions to this most fascinating subject are rather scattered, and a full summary would have been very welcome.

The above notes, which are not the result of a systematic collation of this and the previous edition, but have been culled at random, suffice to show that no pains have been spared to bring before the reader the latest results of geological inquiry. In a rapidly growing science the task of keeping edition after edition of a text-book up to date must be toilsome; it is fortunate when we have an author who has the courage to stick to the work, and power to carry it out with success. It is a welcome fact that this third edition, in spite of its 150 additional pages, is less bulky than the second.

A. H. GREEN.